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## A MONOGRAPH OF THE HELIOZOA.

*Les Heliozoaires d'Eau Douce.* By E. Penard. Pp. 341; illustrated. (Geneva: Henry Kundig, 1904.)

THE Heliozoa or "sun-animalcules" have always been favourite objects with microscopists on account of their abundance, especially in fresh water, their relatively large size, and their beauty as objects for the microscope. From the scientific aspect, however, they have not attracted so much attention as many other groups of Protozoa, on account, perhaps, of their somewhat isolated position from the systematic or phylogenetic point of view, no less than from their perfect innocuousness, so far as mankind is concerned. The work before us is a monograph of the fresh-water Heliozoa, based upon investigations upon those found in the environs of Geneva. It was the author's original intention, he tells us, to have confined himself to a description of the forms occurring in that territory, but since he obtained there nearly all the species hitherto known from fresh water, he has added to his catalogue descriptions of the species which appear not to occur in the sphere of his personal investigations in order to give his monograph a wider basis.

The monograph is divided into four chapters. The first contains general considerations on the structure, reproduction, and affinities of the group; the second gives a systematic account of those fresh-water forms, the position of which among the Heliozoa is above suspicion; the third deals with the "Pseudo-Heliozoa," that is to say, with organisms commonly referred to this group, but of which the affinities and systematic position are dubious; and the fourth discusses synonymic species, namely, those which are of doubtful nature, or which have not been described in a manner adequate for identification. The work further commences with a short introduction and ends with a full bibliography, and is illustrated by numerous text figures.

In his general chapter the author gives first an account of the methods employed by him for collecting these organisms, and then proceeds to consider their body-structure. Under the latter heading he distinguishes two principal types of Heliozoa. The first, or Actinophrys-type, has a large spherical nucleus occupying the centre of the body, and lying, surrounded by a clear zone of protoplasm, in the granular and vacuolated endoplasm, which in its turn is enveloped by the very vacuolated ectoplasm containing a large contractile vacuole. The pseudopodia, seldom longer than the diameter of the body, are supported by relatively strong axial filaments, centred round the nucleus and radiating thence to the periphery of the spherical body. To this first type, which might be called the text-book Heliozoön, may be referred, besides Actinophrys, the genera Clathrulina and Hedriocystis, while Actinosphaerium is derived from it by multiplication of the originally single nucleus. The second or Acanthocystis-type is much commoner; here the centre of the spherical body is occupied, not by the nucleus, but by a central granule, apparently somewhat of the nature of a centrosome, from which radiate

the delicate axial filaments, each passing to the surface of the body to be continued into one of the slender pseudopodia, which usually exceed the diameter of the body in length. The central granule and nucleus are both contained in the endoplasm ordinarily so called, which itself is eccentric in position, so that the surrounding zone of ectoplasm becomes thin on one side of the body and is thickest at the pole opposite to this. The large nucleus is placed eccentrically in the endoplasm, being always near the region where the ectoplasmic zone is at its thinnest, and is therefore still more markedly eccentric in relation to the body as a whole. The author inclines to the opinion that the ordinary use of the terms ectoplasm and endoplasm is incorrect in the case of the Acanthocystis-type of Heliozoön. He thinks that the true ectoplasm is here limited to a narrow peripheral zone of the body, and that the remainder of what is commonly called ectoplasm should really be considered as endoplasm, of which that part to which the term endoplasm is usually applied is only a special region, containing nucleus and central granule, and perhaps homologous with the clear zone round the nucleus in Actinophrys.

In the classification the author keeps to the division into the four well known orders founded by Bütschli, and since repeated in every text-book, although he is decidedly of opinion that this classification "is artificial and does not always correspond to the real affinities of the species." If this is the case, it is a matter for regret that the author did not attempt to embody his ideas of the natural relationships of the Heliozoa in a scheme of classification more suited to express them. He contents himself, however, by making only minor improvements, such as transferring the genus Heterophrys from the Chlamydophora to the Chalarothoraca. He also separates from Bütschli's list certain forms which are placed by him under the heading "Pseudo-Heliozoa." This category, he is at pains to explain, is not intended to have any systematic value, but merely to serve as a mode of uniting "certain organisms which exhibit points of resemblance to Heliozoa sufficiently striking to tempt one to unite them with the latter, and which nevertheless do not belong to the group." Under the Pseudo-Heliozoa are placed various aberrant types the descriptions of which constitute one of the most valuable portions of the book to the student of Protozoa.

For the many interesting details of structure or mode of life of these animalcules described by the author the reader must be referred to the book itself. The following sentences, however, from the section headed "Psychology" merit quotation:—

"If we wish to adopt the chemico-physical theory, so much in favour now-a-days, according to which everything in the lower beings is but mechanical reaction, it is necessary to apply the theory consistently, to examine the higher animals as well as the others, and we shall then be forced to recognise that between the top and the bottom of the psychical scale there is only a descending gradation. Hence, according to this theory, the savant solving a problem should only differ from the Protist in the greater complexity of the physico-chemical reactions. If on the contrary one is led to see something more than matter in the highest manifestations of human thought, this something must

likewise be admitted for the beings lowest in the scale. But then, we may add, on the supposition that the scale rests on pure matter, it is not on the lowest grade that we find the infinitely minute creatures, but already some way up, so much so that the gap separating them from the bottom is infinitely greater than that which they would have to traverse to arrive at the summit."

In conclusion, it may be said that everyone interested in the study of microscopic forms of life will welcome this work from the hand of an enthusiastic observer, who has a most intimate knowledge at first hand with the creatures about which he is writing, and who has achieved a wide reputation as an investigator of the fresh-water Protozoa. The work is weakest on the side which deals with the minuter phenomena of the cell and nucleus, especially in relation to reproduction, the study of which during the last decade has developed with such rapidity and has brought forth results of such fundamental importance in biology. The author is evidently more of a naturalist than of a cytologist, but it is perhaps too much to expect detailed cytological work in a systematic monograph even of a group of Protozoa. As a general survey of the peculiar forms dealt with it will be found most useful, not only as an exposition of the present state of knowledge, but even more as indicating how much still remains to be worked out with regard to the affinities of the Heliozoa and allied forms of life. By directing attention to the many interesting problems these lowly creatures present for solution, it may be hoped that this monograph will act as a guide and stimulus to investigators in all countries.

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### TREES.

*Trees.* By Prof. H. Marshall Ward. Vol. i. Buds and Twigs. Pp. xiv+271. Vol. ii. Leaves. Pp. x+348. (Cambridge: University Press, 1904.) Price 4s. 6d. net each.

AS one might naturally expect from the scant attention which has hitherto been given to the study of forestry in this country, our literature on the subject is by no means what it ought to be. True, we have several standard works, excellent of their kind, which, however, deal with trees more from a sylvicultural than from a botanical aspect. Students of forestry, and especially students of forest botany, and all those interested in the growth and cultivation of trees, have long felt the great want of a suitable text-book or guide to their studies, but happily now, with the appearance of the above handbook from the facile pen of Prof. Marshall Ward, this want has become a thing of the past.

The work will consist of several parts—each part forming a volume—the first of which is already to hand, and treats of buds and twigs. The mere mention of buds and twigs might suggest to some a dry, uninteresting study of minute details; but never was a greater mistake made than to imagine such is the case. The study of our trees and shrubs in their winter condition has a fascination all its own, and, in addition to this, the clear and simple way in which

the author treats the subject is sure to inspire many with interest and enthusiasm for the study of forest botany.

The study of the minute structure of plants in the laboratory has in many cases received the lion's share of attention, with the result that students have been taught to know the internal structure of plants before they were able to recognise these plants in the field. The author clearly recognises this fact, and plainly states that his object is to bring the student more into touch with the plant in its natural surroundings, where he may form a personal acquaintance with it and learn to observe and note facts for himself, and thereby lay a solid foundation for the further study of the biology of the living plant of whatever kind or nature. The opening chapter gives a short but clear account of the general segmentation of the plant. The next eight chapters are devoted to a consideration of buds. The different kinds, structure, position, arrangement, and function are described in a most masterly and interesting fashion. The next seven chapters deal with the different kinds of shoots—their tegumentary systems, leaf-casting and the formation of leaf scars, lenticels, twigs and other accessory characters.

The second portion of the book contains a very comprehensive classification of trees and shrubs according to characters afforded by their buds and twigs. The classification is accompanied by a complete set of illustrations, showing very clearly in pictorial form all those features by which the species may be determined in their winter condition. Most of those drawings have been done by Miss Dawson, of the County School, Cambridge, to whose artistic skill they do great credit. The other illustrations with which the volume teems have been obtained from various sources, and are all duly acknowledged by the author.

The work will be found indispensable to those students who wish to make an expert study of forest botany. At the same time it is expressed in language so clear and devoid of technicalities that the amateur who wishes to know something about our trees and shrubs will find this one of the most useful guides to which he can turn.

Succeeding volumes will deal with leaves, inflorescences and flowers, fruits and seeds, seedlings, and the habit and conformation of the tree as a whole, and each of those volumes, like the present one, will contain diagnostic tables at the end, devised for use in the field.

From the foregoing it will be seen that the work is a many-sided one, acting not only as a guide to the naturalist in the field, but also as a laboratory handbook, where the use of the lens and microscope may be employed to amplify the study of objects already observed in their natural habitats.

Botanists generally, and especially forest botanists, will welcome the appearance of this book as supplying a decided want, and filling a distinct gap in our literature of forest botany.

Since the above was written the second volume has appeared. As already stated, it deals with leaves, and, like vol. i., consists of a general and a special part.

The general part contains an admirable and exhaustive treatment of the external features of leaves,